Emanuele Fedele

New generation of multimodal trains for eco-sustainable rail transport

Tutor: prof. Diego Iannuzzi

Co-tutors: prof. Andrea Del Pizzo

PhD. Ing Luigi Fratelli

Cycle: XXXV   Year: I

My background

- M.Sc. In Electrical Engineering – Università degli Studi di Napoli "Federico II"
- Master thesis at TU Munich (modelling and control of a series hybrid powertrain for small road vehicles)
- Former scholarship with the research group of Electrical Machines, Converters and Drives (ING-IND/32)
- Currently PhD student of the ITEE program
- PhD start date: 01/12/2019
- Scholarship type: MUR (PON Ricerca e Innovazione 2014-2020 - "Dottorati innovativi con caratterizzazione industriale")
- Partner company: Hitachi Rail S.p.A.

Research field of interest

My research activity is related to **railway vehicles** equipped with **onboard energy storage systems** for cleaner operation and wireless capability.

Summary of study activities

- Ad hoc PhD courses

Intelligenza Aritificiale ed Etica: a workshop on ethical and legal issues related to the ever increasing spread of AI in human activities.

Matlab Fundamentals: Matlab training for data collection, organization and processing.

Innovation Management, Entrepreneurship and Intellectual Property: basic concepts on intellectual property, patents, start-ups, creating business from research.

Machine Learning: core knowledge on machine learning algorithms.

Strategic Orientation for STEM Research&Writing: focus on key aspects of successful scientific thinking, reading and writing.

Summary of study activities

- Courses borrowed from MSc curricula

Identificazione e controllo ottimo (prof. Garofalo): optimal control for discrete linear systems, parameter estimation, Bayesian inference and Kalman filtering , system identification and residue analysis.

Elaborazione numerica dei segnali (prof. Scarpa): Z-transform, frequency analysis and filtering, time-frequency analysis, FIR and IIR filters analysis and design.

Machine Learning – Reti neurali e deep learning (prof. Prevete): classification and regression problems, shallow networks, error functions and back-propagation, hyper-parameters tuning, convolutional networks and deep learning.

Summary of study activities

- Conferences

2020 IEEE 20th Mediterranean Electrotechnical Conference (MELECON), Palermo, Italy, 16-18 June 2020 (virtual), *presenting author.*

2020 International Symposium on Power Electronics, Electrical Drives, Automation and Motion, SPEEDAM 2020, Sorrento, Italy, 24-26 June 2020 (virtual).

- Workshop

AI4Rails 2020, Munich, Germany, 7th September 2020 (virtual)
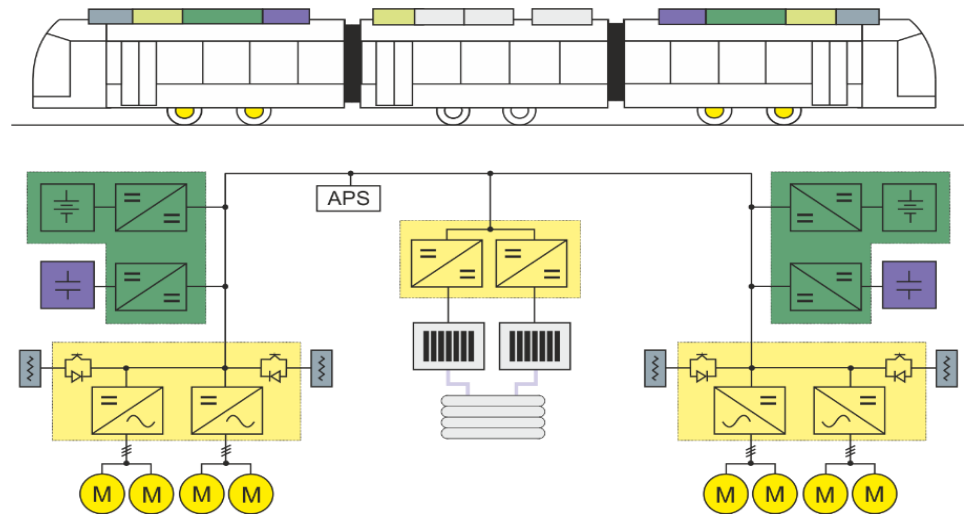
Research activity: overview

- Problem

Diesel-powered trains operated on low and medium traffic routes pose severe environmental issues. On these routes, electrification usually lacks economic feasibility. Moreover, overhead wires have also a strong visual impact especially in city centres.

Multimodal trains with onboard energy storage systems aboard can be a solution, as they enable clean catenary-free operation with improved energetic efficiency.

Research activity: overview

- Objectives

Improved design and control of storage systems and power converters; optimization of energy management strategies to reduce energy demands; development of diagnostic and prognostic algorithms to increase components lifetime and reduce maintenance costs; introduction of new powertrain topologies; identification of multi-objective criteria for validation.

Research activity: overview

- Intended contributions (in perspective)

Introduce alternative powertain architectures and develop effective strategies for their energy management;

Develop algorithms for the condition monitoring and early fault detection of powertrain components;

Identify techno-economic criteria to validate the proposed solutions through the use of simulators and small-scale test benches.

Products

[J1]	Del Pizzo, A.; Di Noia, L.P.; Fedele, E. *"A Simple Analytical Model of Static Eccentricity for PM Brushless Motors and Validation through FEM Analysis"* Energies 2020, 13(13), 3420
[C1]	Del Pizzo, A.; Di Noia, L.P.; Fedele, E. *"An analytical evaluation of rotor eccentricity effects on synchronous drives with surface mounted permanent magnet brushless motors"* 20th IEEE Mediterranean Electrotechnical Conference, MELECON 2020-Proceedings, 2020
[C2]	Dannier, A.; Fedele, E.; Coppola, M. *"Sizing Approach of high torque density motors for aircraft application"* 2020 International Symposium on Power Electronics, Electrical Drives, Automation and Motion, SPEEDAM 2020, 2020

itee PhD
information technology
electrical engineering

Thank you for your attention

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